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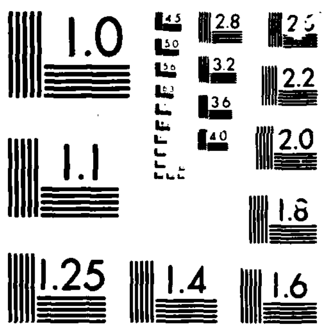

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US Army Corps of Engineers
Los Angeles District

COAST OF CALIFORNIA
STORM AND TIDAL WAVES STUDY

ANNUAL REPORT 1984

AD-A167 635

CCSTWS-85-1
April 1985

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COAST OF CALIFORMIA STORM AND TIDAL WAVES STUDY

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

THIS IS THE SECOND ANNUAL REPORT OF THE CORPS OF ENGINEERS ONGOING COAST OF CALIFORNIA STORM AND TIDAL WAVES STUDY (CCSTWS). THIS REPORT DESCRIBES PROGRESS MADE IN STUDY DESIGN AND DATA COLLECTION DURING 1984.

THIS NONTECHNICAL ANNUAL REPORT IS INTENDED FOR MANY AUDIENCES, AND IT HAS BEEN WRITTEN IN AS SIMPLE ENGLISH AS THE SUBJECT MATTER ALLOWS. WE INTEND IT TO BE AN INTRODUCTION TO THE STUDY FOR THE GENERALISTS IN OUR AUDIENCE, AND AS A NON-TECHNICAL ABSTRACT OF STUDY PROGRESS FOR OUR TECHNICAL AUDIENCES.

THE STUDY HAS SEVERAL OBJECTIVES. ONE OBJECTIVE IS TO STUDY AVAILABLE DATA ON THE COAST, CATALOG IT, AND SUMMARIZE IT FOR PLANNING AND MANAGEMENT PURPOSES. SECOND, THE STUDY IS DESIGNED TO FILL MANY OF THE DATA GAPS IN A SYSTEMATIC WAY. PREVIOUS STUDY HAS TENDED TO BE FRAGMENTED, FOCUSED ON ONE POINT ALONG THE COAST OR ONE REGION. CCSTWS WILL DECIDE THE ENTIRE COAST IN DETAIL FOR THE FIRST TIME. THE PARTICULAR DATA DESIRED BY CCSTWS ARE ON COASTLINE CHANGE AND FACTORS WHICH CAUSE THESE CHANGES. THIRD, THE CCSTWS IS DESIGNED TO ASSEMBLE ALL OF THE DATA COLLECTED INTO A "SEDIMENT BUDGET" FOR EACH LITTORAL CELL OR SUB-REGION ALONG THE COAST. A SEDIMENT BUDGET DESCRIBES IN NUMERICAL TERMS WHAT IS HAPPENING TO SEDIMENTS (SAND) ALONG THE COAST. A FOURTH PURPOSE IS TO USE THE DATA SUMMARIZED IN A SEDIMENT BUDGET TO ASSESS FUTURE SHORELINE CHANGES.

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ANNUAL REPORT, 1984

Ref. No. CCSTWS 85-1

THE COAST OF CALIFORNIA STORM AND TIDAL WAVES STUDY

U. S. Army Corps of Engineers
Los Angeles District, Planning Division
Coastal Resources Branch, SPLPD-CS
P.O. Box 2711
Los Angeles, CA 90053-2325

THE COAST OF CALIFORNIA STORM AND TIDAL WAVES STUDY

PREFACE

This is the second annual report of the Corps of Engineers' landmark study of the coast of California. The report describes progress made in study design and data collection during 1984.

This non-technical annual report is intended for many audiences, and it has been written in as simple English as the subject allows. We intend it to be an introduction to the study for the generalists in our audience, and as a non-technical abstract of study progress for our technical audiences. Anyone interested in the technical reports of study progress will find a list of such reports on the page following this preface. These may be obtained by writing either Los Angeles or San Francisco districts:

U. S. Army Corps of Engineers
Los Angeles District
Coastal Resources Branch, SPLPD-CS
ATTN: CCSTWS PROJECT MANAGER
P.O. Box 2711
Los Angeles, CA 90053-2325

U.S. Army Corps of Engineers
San Francisco District
Water Resources Branch, SPNPE-W
ATTN: CCSTWS PROJECT MANAGER
211 Main Street
San Francisco, CA 94105

Since we are currently updating our mailing list and wish to minimize costs, we will mail reports only to those who express an interest in remaining on the list. To remain on the CCSTWS mailing list, please fill out the request form at the end of this report.

The CCSTWS is a cooperative effort between the Corps' Los Angeles and San Francisco Districts. It is a long-term study designed to improve our practical knowledge of how California's coast is changing. We welcome public participation in this important study.

PREVIOUS CCSTWS REPORTS

Title	Date	Ref. No.
CCSTWS Plan of Study	Sept. 83	----------
Annual Report, 1983	April 1984	CCSTWS 84-1
San Diego Region Plan of Study	April 1984	CCSTWS 84-2
Nearshore Bathymetric Survey Report 1	April 1984	CCSTWS 84-3
San Diego Region Geomorphology Framework Report	Sept. 1984	CCSTWS 84-4
Sediment Sampling Dana Point to the Mexican Border	Nov. 1984	CCSTWS 84-5

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THE COAST OF CALIFORNIA STORM AND TIDAL WAVES STUDY

INTRODUCTION

The Coast of California Storm and Tidal Waves Study (CCSTWS) is a response to the critical need for information about California's changing coastline. It is a study of the entire 1,100 miles of California's coast, an attempt to gain a better understanding of what is happening to California's beaches and shore, and an attempt to understand the factors bringing about these changes. The study goal is to give engineers, planners, and resource managers the information they need to make sound decisions about projects affecting the coast.

STUDY OBJECTIVES

There are several study objectives. One objective is to survey available data on the coast, catalog it, and summarize it for planning and management purposes. Second, the study is designed to fill many of the data gaps in a systematic way. Previous study has tended to be fragmented, focused on one point along the coast or one region. CCSTWS will describe the entire coast in detail for the first time. The particular data desired by CCSTWS are data on coastline change and factors which cause these changes. Third, the CCSTWS is designed to assemble all of the data collected into a "sediment budget" for each littoral cell or sub-region along the coast. A sediment budget describes in numerical terms what is happening to sediments (sand) along the coast (Figure 1). A fourth purpose is to use the data summarized in a sediment budget to assess future shoreline changes.

STUDY PARTICIPANTS

This is a cooperative study involving many Corps and outside groups. The study is being managed by the Los Angeles District, and much of the research is being carried out by technical staff from the Los Angeles and San Francisco districts. In addition, the Corps' Coastal Engineering Research Center (CERC) is actively involved in the study, as is the National Oceanographic and Atmospheric Administration (NOAA). Cooperative relationships are being maintained with major universities, as well as with the State of California and local government agencies responsible for the coast. In short, CCSTWS brings together many of those who have been working independently for many years. CCSTWS will create new information about the coast and synthesize what is currently known.

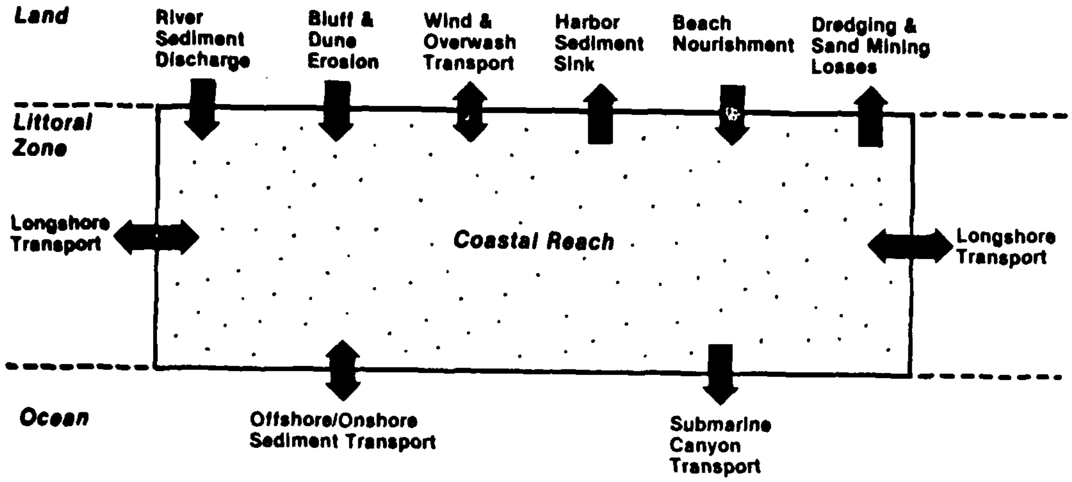


Figure 1. A conceptualization of the "sediment budget" for a littoral cell or zone. Arrows indicate the ways in which sediment is added to or removed from a particular area along the coast.

STUDY SCOPE

For administrative as well as scientific reasons, the California coast has been divided into six study regions (Figure 2). These regions are geographically distinct from one another in enough ways so that study by region is appropriate. The characteristics of the regions are described in detail in the Annual Report, 1983. Without repeating the information presented in the first annual report, it is important to note that the six regions shown in Figure 2 differ from one another in weather, exposure to storms and deep-ocean waves, geography, geologic characteristics, and state of human development/use of the coast. The North Coast Region, with its miles of virtually untouched beaches, is very different from the South Coast Region with its beaches crowded by millions of people a week.

The CCSTWS includes study of six major categories:

* Coastal Processes
* Geomorphology
* River Hydrology and Hydraulics
* Regional Socioeconomics
* Oceanography and Meteorology
* Survey and Mapping

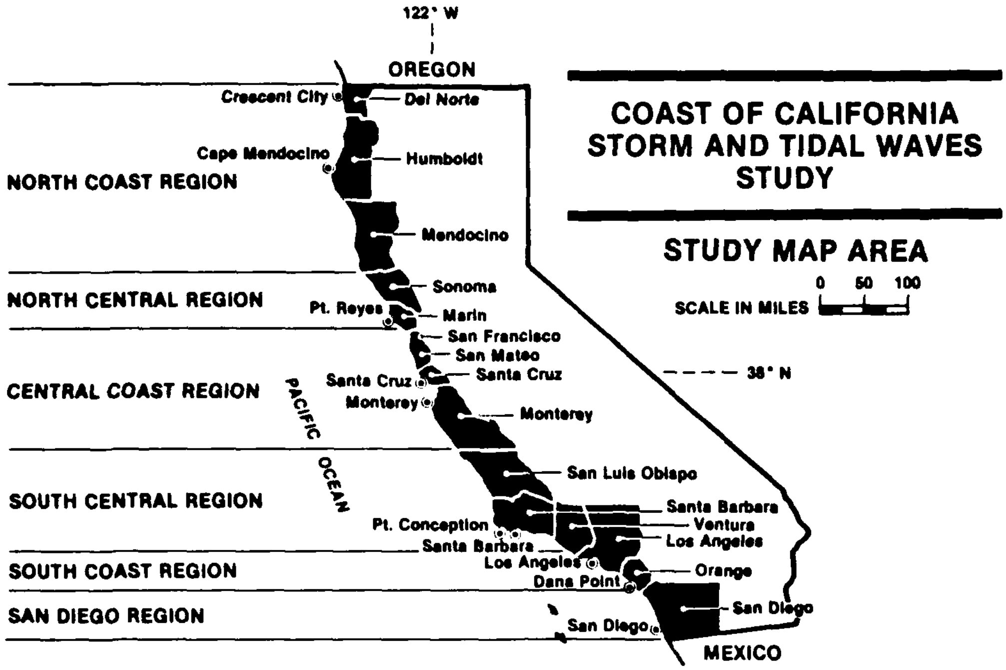


Figure 2. The six regions of the Coast of California Storm and Tidal Waves Study.

Data about all six categories will be collected for each of California's six coastal regions. A general view of the scope of each study can be gained from Table 1, which shows the major subjects to be covered under each category.

STUDY PROCESS

A study of this magnitude is necessarily quite complex. The basic flow of the study, however, is relatively simple:

* First, a bibliography of existing reports about each region must be compiled.

* Second, the reports in this bibliography must be reviewed to determine the state of knowledge about the region. We must establish what is known in order to avoid duplicating data collection efforts. This review of current knowledge is critical to study efficiency, as field data collection is costly. One product of this review will be an extensive report summarizing available knowledge on all six categories of data for each region. To our knowledge, no previous study has synthesized such data on this scale.

* Regional study plans are the next step. These plans will describe all of the studies to be undertaken, specifying exactly where and when data will be collected.

* The field data collection will be undertaken following regional study plan formulation. This multi-faceted effort will require several years.

* Finally, data will be compiled in several forms. First, summary reports will be prepared. Next, a permanent computerized data base will be developed.

The product of this massive study, the extent of which is clear from Figure 3, a diagram of the general study flow, will be a coherent view of what's happening in every region of the California coast, and a comprehensive review of the factors affecting the coastline. From this, it will be possible to assess more accurately where problems are likely to occur, and to identify more effectively measures to preserve and enhance California's coastline.

Table 1. Data to be collected by CCSTWS, by category. Data on each subject listed will be collected for each of the six regions in California.

DATA CATEGORY	SPECIFIC SUBJECTS COVERED BY STUDY
Coastal Processes	a. Seasonal and long-term amounts of sediment being transported onshore and offshore. b. Processes responsible for on/offshore transport. c. Historic changes in onshore/offshore transport. d. Seasonal and long-term amounts of sediment being transported along the shoreline (up coast and downcoast). e. Processes responsible for longshore transport. f. Historic changes in longshore transport. g. Nearshore and longshore currents. h. Sediment brought inland via overwash. i. Sediment trapped or transported by/in harbors and bays. j. Wave climate data, including offshore sea, swell, tides and tsunamis. k. Factors affecting (transforming) waves as they approach the shore. l. Wave hindcast data. m. Water level changes, including tides, extreme tidal events such as storm tides, and sea level changes. n. Beach and shore erosion, both long-term and seasonal. o. Coastal structures, including shore protection, beach nourishment projects, and any structures which modify sediment transport, sediment sources, or sediment sinks. p. Impact of environmental resources on coastline. q. A sediment budget for each littoral cell in the region.
Geomorphology	a. Coastal geological features -- dunes, headlands, rocks, estuaries, and others.

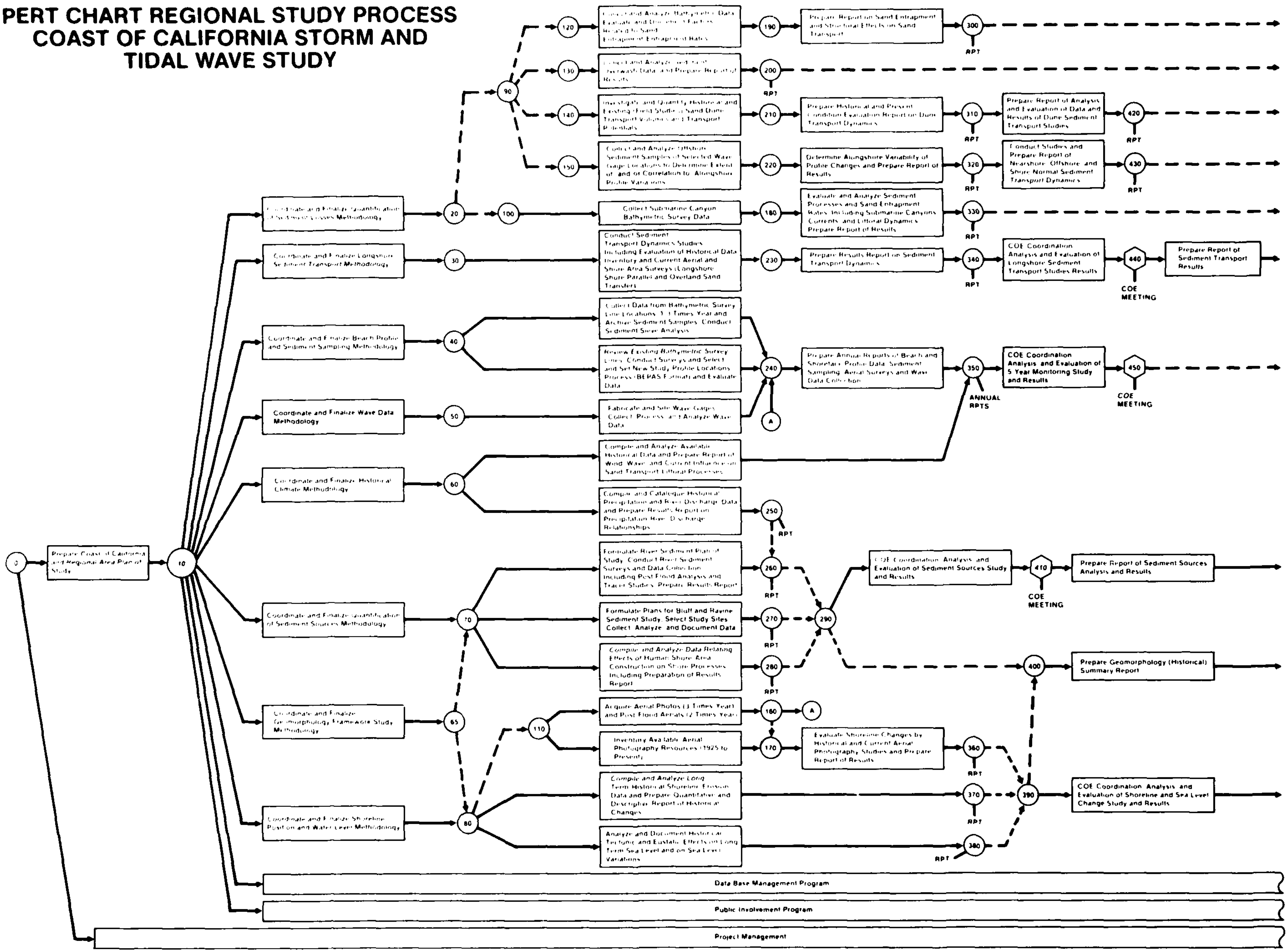
Table 1, continued.

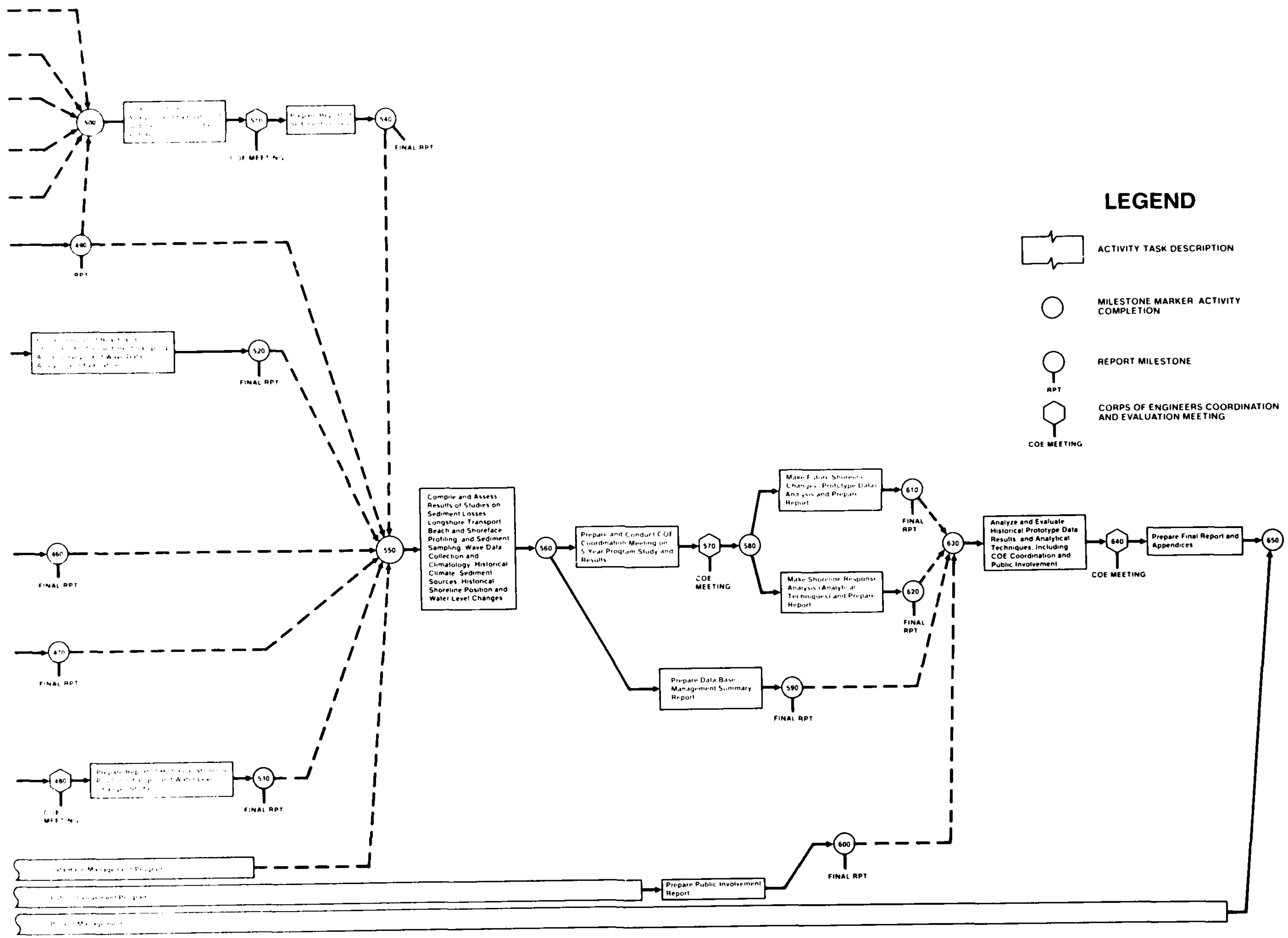
DATA CATEGORY	SPECIFIC SUBJECTS COVERED BY STUDY
Geomorphology (continued)	b. Inland and offshore geological features. c. Sediment source and characteristics data. d. Geologic processes. e. Land mass changes such as subsidence and uplift, as well as tectonic movement. f. Sand and gravel mining in coastal rivers and streams, and its impact on coast.
River Hydrology and Hydraulics	a. River flows and sediment discharge rates, historic and current. b. Drainage basins. c. Historic flood events. d. Wind generated sediment transport.
Regional Socioeconomics	a. Status of coastal development. b. Coastal erosion problems.
Oceanography and Meteorology	a. Wind climate, including major storms, seasonal and long-term trends, and local wind effects. b. Major ocean currents. c. Climate and rainfall history.
Survey and Mapping	a. Aerial photography. b. Historic maps. c. Inventory of coastline benchmarks. d. Beach/shoreline profiles.

The complexity of this study is evident from this table, and from the general PERT chart for study of each region (Figure 3).

Figure 3. (Overleaf) Regional Study PERT Chart

PERT CHART REGIONAL STUDY PROCESS COAST OF CALIFORNIA STORM AND TIDAL WAVE STUDY





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ACTIVITY TASK DESCRIPTION
MILESTONE MARKER ACTIVITY COMPLETION
REPORT MILESTONE
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CORPS OF ENGINEERS COORDINATION AND EVALUATION MEETING
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500
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550
Compile and Assess Results of Studies on Sediment Losses Longshore Transport Beach and Shoreface Profiling and Sediment Sampling Wave Data Collection and Climatology Historical Climate Sediment Sources Historical Shoreline Position and Water Level Changes
560
Prepare and Conduct COE Coordination Meeting on 5 Year Program Study and Results
570
COE MEETING
580
Make Future Shoreline Changes (Prototype Data) Analysis and Prepare Report
610
FINAL RPT
Make Shoreline Response Analysis (Analytical Techniques) and Prepare Report
620
FINAL RPT
Prepare Data Base Management Summary Report
590
FINAL RPT
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600
FINAL RPT
630
Analyze and Evaluate Historical Prototype Data Results, and Analytical Techniques, Including COE Coordination and Public Involvement
640
COE MEETING
Prepare Final Report and Appendices
650

THE COAST OF CALIFORNIA STORM AND TIDAL WAVES STUDY

1984: A REVIEW OF CCSTWS PROGRESS

In 1983 the focus of CCSTWS was on developing a detailed plan of study and initiating data collection efforts for the San Diego Region. This region was chosen as an initial focal point for two reasons. First, the region has numerous critical coastal erosion problems. Second, the planning effort for the San Diego Region would serve as a model for study development for the five other coastal regions. The work on the San Diego Region has contributed significantly to study design for other regions.

THE EXPANSION OF CCSTWS SCOPE

The dominant thrust of CCSTWS during 1984 has been on expanding the study to all six coastal regions in California. In 1984, the San Francisco District has become a partner in the CCSTWS, and development of the framework for field studies in the five as-yet-unstudied regions has begun.

For several reasons, 1984 was chosen as the year for expansion. First, the study of the San Diego Region had progressed enough to make planning for other regions feasible. Lessons learned from the San Diego Region field studies could be applied to new planning, ensuring an efficient study of the entire coast. Second, the data needs for the study could be refined and field data collection techniques updated based on San Diego Region study. Field studies continue in the San Diego Region, but the main thrust of CCSTWS during 1984 was to initiate state-wide study.

THE STUDY EXPANSION PROGRAM

The first step in expanding the CCSTWS's geographic scope was to begin developing a bibliography of data already available on the coast. Both Los Angeles and San Francisco District staff have participated in this effort, which at this writing is approximately 70 percent complete. The bibliography being prepared lists data sources for all six categories of data required for the CCSTWS: 1) Coastal Processes, 2) Geomorphology, 3) River Hydrology and Hydraulics, 4) Regional Socioeconomics, 5) Oceanography and Meteorology, and 6) Survey and Mapping. The bibliography, with its annotations for key documents, is being computerized and will be available in both hard copy and disk form. See page 15 for more detailed description of this effort.

REGIONAL PLANS OF STUDY

Work began in 1984 on development of regional plans of study for the five as-yet-to-be-studied regions of California. A key portion of this effort has been review of available data on the six categories of data needed by CCSTWS. This time-consuming review is partially underway. By fall of 1985, available data for all six CCSTWS data categories will be summarized for all six California regions.

QUARTERLY BULLETINS INITIATED

In addition to annual reports, CCSTWS staff will prepare a quarterly bulletin to ensure that all those interested in the study are kept up-to-date. The first bulletin was circulated this Spring. The next bulletin will be available in July.

A SUMMARY OF 1984 TECHNICAL ACTIVITIES

While study expansion has been underway, the field data collection has continued in the San Diego Region and in several other locations. In addition, data collection techniques have been under review for the purpose of updating them where necessary. Thus, there are study results to report, and new techniques to describe.

SEDIMENT SAMPLING FOR THE SAN DIEGO REGION

Characterization of shoreline sediments is essential to determining where these sediments have come from and how sediments are moving along the coast. Sediment samples were taken along 21 profile lines from Dana Point to the Mexican Border. Sediment texture and mineral composition were both evaluated.

There were several significant findings of this sediment sampling. River contributions to sediment in several coastal zones were identified, and an unexpected distribution of minerals was found. Where it was once thought that the mineral distribution was uniform for the region, the 1984 sediment sampling found three distinct zones of different mineral composition, indicating a different source and distribution of sediments for each zone. An outline of results of this study begins on page 19 of this report.

SHORELINE CHANGE MAPPING STUDY: SOUTH COAST AND SAN DIEGO REGIONS

One early phase of each regional study will be to gather historic map and survey data, compare maps and surveys from different years, and determine the extent to which the coastline has changed over the approximately 100-year period for which maps and surveys are available. This coastline change study was conducted in 1984 by the NOAA's National Ocean Service (NOS), and the Corps of Engineers' Coastal Engineering Research Center (CERC). The entire San Diego Region was studied, along with the portion of the South Coast Region from Dana Point to Portuguese Point (near Los Angeles-Long Beach Harbors).

In general, maps and surveys were available for a span of 80-100 years, with a few older maps available for some areas. The <u>average</u> change in mean high

water (MHW) line for each 1-minute (approximately 4.3 miles) segment of the coast was calculated.

A discussion of this mapping study begins on page 23 of this report; however, data have not been fully analyzed at this time. A summary analysis will be included in the next CCSTWS quarterly bulletin.

NEARSHORE BATHYMETRIC SURVEY, SAN DIEGO REGION, SECOND YEAR

Precise knowledge of the nearshore ocean bottom profile is necessary in order to determine where and how much sediment is moving in a given area. Profiles, taken with hydrostatic profiler mounted on a submersible sled, have been underway since 1983 (see Annual Report, 1983 for a full description of the technique). The second year's profiling, conducted by the Ocean Engineering Research Group of Scripps Institution of Oceanography, was completed in December 1984. An improved version of the hydrostatic profiler was used for these studies, which also included sediment sampling.

It is too early to analyze these data to determine if significant changes are occurring in bottom profiles, but a preliminary analysis is scheduled to be released late this year. A summary of data collected begins on page 25.

NEW BUOY FOR MEASURING DIRECTIONAL WAVE SPECTRA DEPLOYED OFF SOUTHERN CALIFORNIA

Detailed data about waves approaching the California coast are an important part of the CCSTWS. It is essential to know offshore wave direction, period, and height in order to understand how waves influence sediment movement along the coast.

In cooperation with the Corps of Engineers, NOAA has placed an advanced wave measuring buoy off the southern California coast about 120 miles (185 km) southwest of Los Angeles. This is far enough offshore to give accurate readings of deep water waves before they can be influenced by coastal features. This buoy will provide a continuous stream of data on wave climate to NOAA and Corps researchers. A complete description of the buoy and the data it will provide begins on page 31.

NEW METHOD DEVELOPED FOR NEARSHORE BATHYMETRY

The hydrostatic profiler used in the first two years of study in the San Diego Region will soon be replaced by a new device developed by the CERC. The new device consists of a sled with a tall (60-foot) mast. Two reflectors are attached to the top of the mast. As the sled is pulled seaward by a small boat or amphibious vehicle (Figure 4), a laser beam from a Zeiss survey instrument tracks the reflectors, recording the decline in mast height relative to a benchmark on the shore. The laser is extremely precise, with a greater range than the hydrostatic profiler, and thus more accurate profiles are expected. A description of this system begins on page 27.

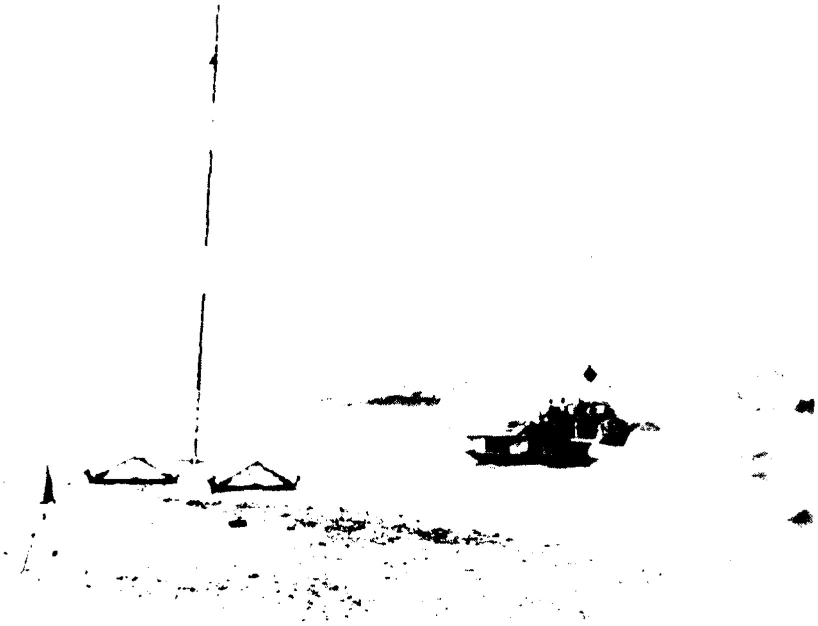

Figure 4. A new laser-reflector profiling device mounted on a sea sled, a version of which will be used in future profiling, shown being towed through the surf.

GEOMORPHOLOGY FRAMEWORK STUDY, MONTEREY BAY

Specific study of regions other than San Diego began this year in Monterey Bay with the beginning of the Geomorphology Framework Study. In this study, the United States Geological Survey (USGS) is compiling available data on geologic and geomorphic characteristics of Monterey Bay. Using these data, the forces responsible for the coastline formation will be analyzed, and a detailed plan for sediment sampling will be prepared. This study is similar to the geomorphology review of the San Diego Region described in the 1983 Annual Report. An overview of this year's study begins on page 33.

SUBMARINE CANYON SEDIMENTATION STUDY

Sand losses to submarine canyons along the coast may be one of the most important factors contributing to loss of beaches in Southern California. Sediments lost to deep canyons are lost permanently. Given the present cost of artificially placed beach fill to replace sediment losses (from $2 to $10 per cubic yard), study of sediment losses to canyons is important.

The immediate objective of the submarine canyon sedimentation study is to determine loss rates for the important La Jolla and Carlsbad canyons, and to determine what forces are responsible for moving sediment into these canyons. A related objective is to determine if there are methods for reducing losses, perhaps by stabilizing sediment in canyon entrances.

The study, carried out by Moffatt & Nichol, Engineers and their sub-contractor San Diego State University, involves dive surveys, placement of sediment traps, and bathymetric measurements.

Preliminary observations include recording the flushing of sediment built up in the Scripps Canyon during a major storm event, and measurement of infilling rates for Scripps and La Jolla canyons. Infilling during the study period appears to be at a slower rate than previously indicated. An overview, with some preliminary observations, begins on page 35.

TECHNICAL SUMMARY: THE CCSTWS BIBLIOGRAPHY OF DOCUMENTS DESCRIBING CALIFORNIA'S COASTLINE

INTRODUCTION

A comprehensive annotated bibliography describing available literature on the coast of California is important because it makes efficient field study and interpretation of data possible. In particular, knowing what literature is available helps CCSTWS and other researchers decide what the major gaps are in knowledge of the California coast. Development of such a bibliography, which does not exist elsewhere, was an essential first step in expanding the scope of the CCSTWS to all six California regions.

METHODS

The initial step in developing the bibliography was to determine what topics were to be included. A review of several standard texts/reports and a roundtable discussion of the scope of CCSTWS produced a list of 64 specific subjects of interest, these related to the six main categories of data needed for CCSTWS to achieve its goals (Table 2).

Documents containing these types of data about the California coast were then searched using computer facilities and by referring to the bibliographies of major technical reports. The bibliographies of major textbooks in each field were examined. In addition, authorities in the field were consulted, and the collections of major universities were reviewed. The result is a bibliography which contains citations from the technical (journal) literature and citations from technical reports published by major research/planning groups such as the Corps of Engineers, NOAA, and the State of California Resources Agency.

Each item identified has been reviewed by Corps personnel, who then prepared descriptive annotations of key documents. Bibliographic entries are not abstracts of the documents, but rather descriptions of what they contain.

THE BIBLIOGRAPHY

A sample bibliographic entry is shown in Figure 5. Approximately 2,500 such entries will be made before the bibliography is completed in late spring 1985. By end of 1984, over 1,000 documents had been identified and catalogued.

Table 2. Topical Key Words for CCSTWS Annotated Bibliography. Data about these items will be found in the documents included in the bibliography. The bibliography may be searched using these key words.

1.	aerial photography	33.	petrology
2.	beaches	34.	population
3.	beach nourishment	35.	precipitation
4.	beach profiles	36.	property value
5.	bench marks	37.	remote sensing
6.	cliff sediment	38.	reservoirs
7.	climatology	39.	river-bed sediment
8.	coastal currents	40.	river discharge
9.	coastal erosion	41.	river sediment discharge
10.	coastal erosion problems	42.	sand bars
11.	coastal structure	43.	sand entrapment
12.	deltas	44.	sea level change
13.	dunes	45.	sedimentation
14.	El Nino	46.	shoreline change
15.	environmental constraints	47.	shoreline use
16.	estuarine sediment storage	48.	shore protection
17.	fires	49.	stream gaging
18.	geology	50.	storm damage
19.	geomorphic processes	51.	storms
20.	grain size	52.	storm surge
21.	growth potential	53.	storm waves
22.	hydrographic surveys	54.	submarine canyons
23.	institutions	55.	tidal inlets
24.	littoral sediment	56.	tides
25.	longshore current	57.	tsunamis
26.	longshore transport	58.	urbanization
27.	maps	59.	watersheds
28.	mining	60.	watershed sediment
29.	nearshore currents	61.	wave climate
30.	neotectonics	62.	wave transformation
31.	offshore/onshore transport	63.	wind
32.	overwash	64.	wind transport

The bibliography has been placed in a computer data base which allows search by:

1. Author

2. Data Category

3. Geographic Key Word

4. Topical Key Word (Table 2).

When completed, the bibliography will also be available in hard copy, as a report.

DISCUSSION

This bibliography will be useful for CCSTWS and for any other research or planning effort dealing with California's coastline. CCSTWS staff will soon begin abstracting the data in it as a part of efforts to prepare regional plans of study for CCSTWS. It will also serve other researchers, as there is no quick-reference guide to the literature such as this bibliography. The bibliography will make review of the literature relatively easy.

INTERNAL REF. NO: 215

COAST OF CALIFORNIA STUDY BIBLIOGRAPHIC DATA SHEET

REPORT/STUDY SOURCE:

REPORT/STUDY AUTHORS:

(1) Inman, D. L.
(2) Komar, P. D.
(3) Bowen, A. J.
(4)

REPORT/STUDY DATE (mo/day/yr): 01/ 01 / 68

REPORT/STUDY TITLE: Longshore Transport of Sand

CITATION (journal or publisher, volume, pages, etc.): Proceedings of 11th Conference on Coastal Engineering, London, England, ASCE, N. Y.; Vol. 1, pp. 298-300

DESCRIPTION: Simultaneous field measurements of the energy flux of breaking waves and the resulting longshore transport of sand in the surf zone have been made along three beaches for a variety of wave conditions. The measurements indicate that the longshore transport rate of sand is directly proportional to the longshore component of wave power. This is a preliminary report of a continuing study at El Moreno Beach, Gulf of California; Silver Strand Beach, Coronado and Scripps Beach, La Jolla, California.

CATEGORY: : 1 : : : : : : Coastal Processes

TOPICAL KEY WORDS: : 26 : 61 : 25 : 62 : 24 : : longshore transport, wave climate, longshore current, wave transformation, littoral sediment

GEOG. KEY WORDS (state, region, subregion, cell or reach):
: 1 : 14 : 65 : 3 : 19 : 69 : : : California, San Diego Region, Oceanside Cell, Mexico, Subregion X, Silver Strand Cell

LOCAL DOCUMENT LOCATION: SPLPD-CS-CCS

DOCUMENT REF. SOURCE AND ID: na

Figure 5. Sample bibliographic worksheet from CCSTWS Annotated Bibliography.

TECHNICAL SUMMARY: SEDIMENT SAMPLING

DANA POINT TO THE MEXICAN BORDER

INTRODUCTION

An accurate characterization of beach and nearshore sediment is essential to determining beach sediment sources and patterns of littoral transport. Both sediment texture and mineralogical content are needed to determine sources, transport paths, and mechanisms for transport.

METHODS

Sediment samples were collected by Scripps Institution of Oceanography along 21 range line locations, covering three littoral cells: Silver Strand Littoral Cell, Mission Beach Littoral Cell, and Oceanside Littoral Cell (Figure 6). Sediment sampling was conducted in conjunction with hydrographic profiling work, thus reducing study costs. Range lines were selected to ensure a representative sampling program.

Samples were collected using a handline-operated "Petite Ponar" grab dredge (Figure 7). Samples were taken at a variety of points along each range line, from about 6 feet above MLLW to -19 feet MLLW. Sampling was conducted from November 1983 to January 1984.

Laboratory analysis included grain size determination using a visual accumulation tube. Results from this technique were compared to those obtained with a standard sieve analysis and no significant difference in results was identified.

Grain shape was determined using a binocular microscope at 70x magnification.

Two separate mineralogic determinations were made (quartz-feldspar and heavy mineral abundances, and heavy mineral identification) using at least 350 grains from each sample. These grains, permanently mounted on a glass slide, were ground, etched with hydro-fluoric acid, and stained to determine the four types of minerals to be counted. Heavy minerals were separated from quartz-feldspar using heavy liquid Bromoform (density 2.90). Mineral samples were placed in the Bromoform, and heavy minerals which settled to the bottom were retained and later analyzed using a petrographic microscope at 100x to 500x magnification.

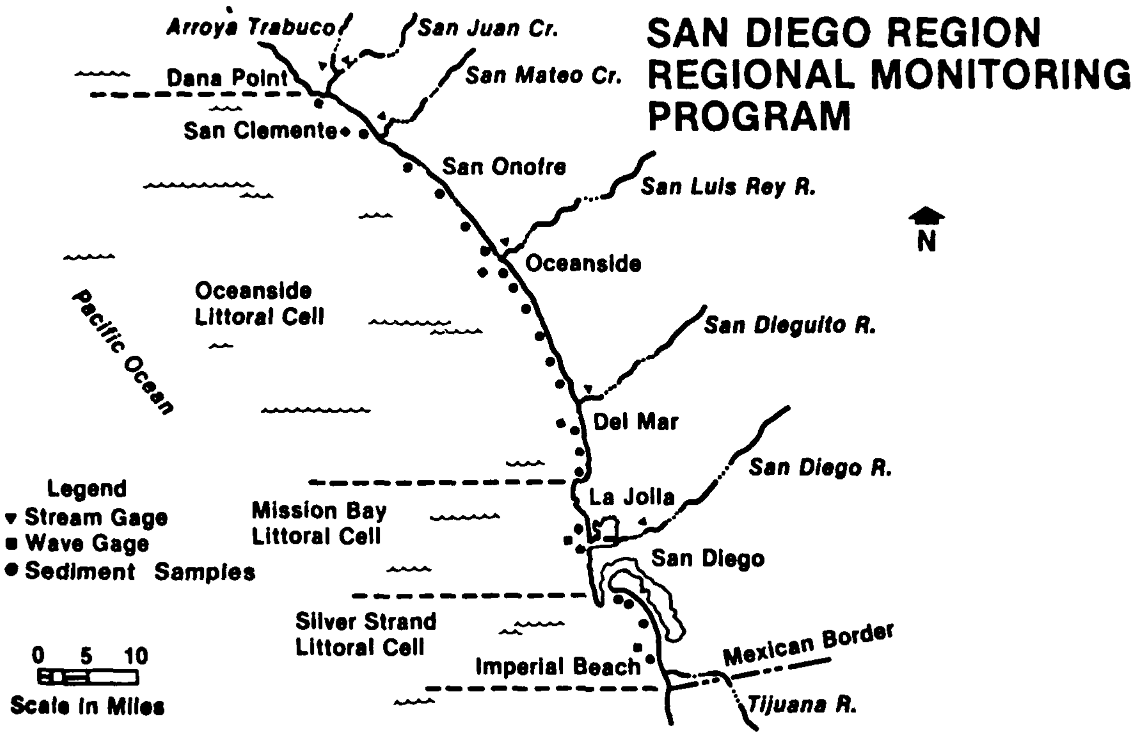

Figure 6. The San Diego Region, its three littoral cells, and the 21 range lines used for sediment sampling in this study.

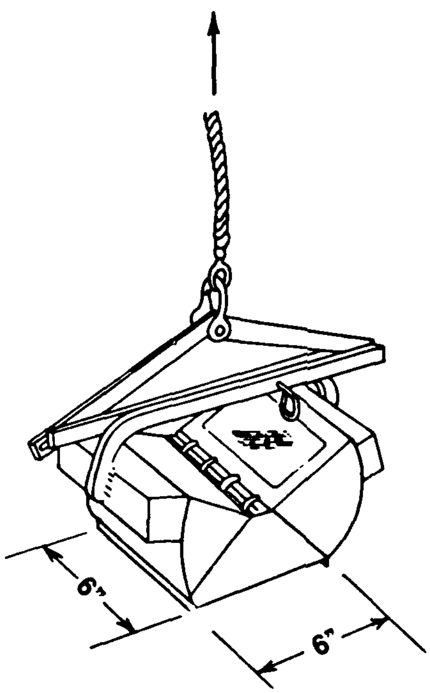

Figure 7. The "Petite Ponar" dredge used in this study.

RESULTS

Detailed tables of grain sizes and mineral composition are available in report CCSTWS 84-5, November 1984. Key data relationships are summarized here.

SILVER STRAND LITTORAL CELL

Data from the four range lines sampled in this cell (October 20-25, 1983) are consistent with data from previous studies (1937 and 1967) in that median grain size decreases with distance from the Tijuana River, thus suggesting that the Tijuana River is a major source of sediment in this cell. While overall median grain size in this study was larger than in the 1967 study in some locations, the distribution trend was the same.

Mineralogic analysis indicated feldspar minerals were most abundant and that heavy minerals were more abundant near the river delta than at more distant sites. These data indicate a riverine source for Silver Strand sediments; the high concentrations of feldspar minerals and heavy minerals are consistent with results obtained near river mouths in the Oceanside Littoral Cell.

MISSION BEACH CELL

Data from two range lines (October 19, 1983 and November 1, 1983) were analyzed for this small littoral cell. Texture data suggest a net upcoast littoral drift. High quartz concentrations in the downcoast sample (Ocean Beach) suggest a marine source for these sediments, while high feldspar concentrations in the upcoast sample (Pacific Beach) suggest a riverine sediment source.

Heavy minerals in the two samples included brown hornblende, rock fragments, and clinozoisite-epidote minerals. Mineral composition was different from that of the Silver Strand Cell. Sediment sampling in inland watershed areas is necessary before source conclusions can be made for this cell.

OCEANSIDE LITTORAL CELL

This large littoral cell can be divided into seven sub-cells (Figure 6). In all, 16 range lines were sampled in this cell, at least one per sub-cell.

The sediment characteristics of the sub-cells vary considerably (Table 3), suggesting that local sources have a considerable influence. The Oceanside Cell appears to be a complex area with numerous sediment sources and transport pathways.

REGIONAL TRENDS

One significant finding of this sampling program was significant differences in mineral assemblages in the region, a result which contradicts previous surveys. The percentages of epidote and hornblend sediments varied significantly. The Silver Strand Cell had very low epidote abundance (0.0 to 1.9 percent). Epidote abundance in the Mission Beach Cell and the southern (downcoast) portion of the Oceanside Cell increased by approximately a factor of 5 (1.3 to 10.0 percent) with a corresponding decline in hornblende abundance. North of Oceanside Harbor,

epidote abundance increased dramatically, from 15.7 to 33.3 percent. These assemblages are closely related to the types of rock exposed in local drainages.

DISCUSSION

These data confirm the importance of riverine sediment to the beaches of the San Diego Region, and suggest further that local coastal runoff in the immediate vicinity of the coastline may contribute heavily to the region's littoral sediment supply. In many of the samples, sediment characteristics indicate that local cliffs are a significant sediment source.

Table 3. Sediment characteristics of the Oceanside Littoral Cell's seven sub-cells.

SUB-CELL	DOMINANT CHARACTERISTICS	POSSIBLE SOURCES
Pt. La Jolla to San Dieguito River	Grain size distribution skewed towards course.	Local landslides have contributed significantly.
San Dieguito River to Buena Vista Lagoon	Coarser sediments than from down-coast cell.	Local cliffs are being eroded by waves and rain.
Buena Vista Lagoon to Oceanside Pier	Fine-grained sediments.	Artificial beach nourishment is source, dredged sediments from harbor.
Oceanside Harbor to Oceanside Pier	Coarser than downcoast, and much better sorted.	Probably a more accurate indicator of natural sediment than downcoast cell.
Oceanside Harbor to Las Flores Creek	————	————
Las Flores Creek to San Mateo Creek	Fine-grained gravel, very coarse sediments.	High storm flows in 1982 may have brought sediments.
San Mateo Creek to San Juan Creek	Gravels, as above, especially near creek mouth.	In 1982, storms may have brought coarse sediments to shore.

TECHNICAL SUMMARY: SHORELINE CHANGE STUDY

USING HISTORIC MAPS AND SURVEYS

INTRODUCTION

Historic maps and surveys can be a useful tool in identifying long-term coastline changes. While their accuracy is often less than that obtainable with modern survey methods, and data are not available for all years and all areas of the coast, historic maps can give some general information about what is happening along the coast and what has caused some of the changes.

To use historic maps successfully, a complete set of maps and surveys must be obtained, and the spatial information on them must be translated into numerical values. When this is done, changes can be expressed in terms of positive (+) or negative (-) movement of some standard unit of measure such as mean high water line. If this line moves seaward relative to an established benchmark, then the shore is experiencing an accretion. If it moves shoreward, there is erosion.

The first in a series of studies, this analysis of historic maps and surveys covered the area from Portuguese Point (Los Angeles County) to the U.S. Mexican border, or about 146 miles of Pacific coastline. Results to date have not been analyzed completely, and, thus, this is a preliminary report. No attempt has yet been made to associate any identified changes with causative factors

METHODS

One hundred and twenty-seven historical NOS maps were identified for this area, ranging in scale from 1:5,000 to 1:20,000 and dating from 1851 through 1974. Fifteen 1:24,000 USGS quadrangles were used as base maps for this survey, and latest NOS maps were also consulted.

In addition to reviewing these existing maps, 68 aerial photographs were taken over the survey area. Twenty of these were enlarged to 1:24,000 scale and used to plot the 1982 shoreline. Mean high water line (MHW) was used as the point of measurement for identifying changes in coastline. Stereoscopic examination of the photographs was made to set 1982 MHW line.

Historic maps were copied onto a stable base Mylar film for analysis, this copying process introducing an error of ± 16.5 feet at 1:24,000 scale. The maximum error in measurement for all maps was determined to be equivalent to ± 33 feet ground measurement, with many maps yielding more precise results. It is clear

that minor shifts in MHW line are not significant.

For analysis purposes, the 146-mile coastline was divided into reaches of 1-minute latitude or longitude distance (approximately 4.3 miles). The average seaward or shoreward change in MHW line for the entire 1-minute reach was determined to be the most meaningful way to report results, as results for individual points are subject to significant bias. The transect approach used in analyzing each coastline segment is illustrated in Figure 8.

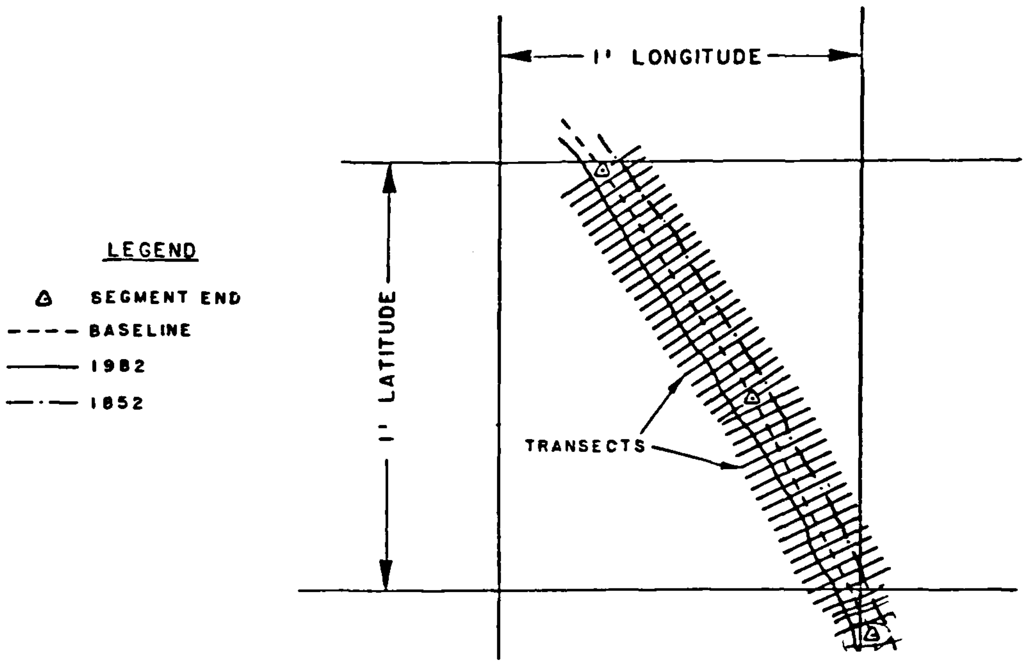

Figure 8. 1-minute latitude or longitude areas used as the basis for analyzing net coastline movement seaward or shoreward.

Net movement of the MHW line was calculated by measuring movement along a number of equally spaced transects marked on composite maps. The movement along each transect was then summed. Average yearly net gain or loss of mass along the coastline was then calculated.

RESULTS

Data analysis is now underway, but has proved more complicated than anticipated. The use of average change per 1-minute x 1-minute area produced some anomalies in results because beach change was often averaged with change in very stable cliffs and rocky shoreline. No definitive conclusions about accretion and erosion rates can be drawn for the 146-mile study reach. Nevertheless, the analysis will help identify long-term trends.

TECHNICAL SUMMARY: NEARSHORE BATHYMETRY, SAN DIEGO REGION, SECOND YEAR STUDY

INTRODUCTION

Detailed profiles of the beach and nearshore ocean bottom are necessary to determine where sediments are eroding and accreting along the coast. Precision is essential, because a minor increase or decrease in profile elevation over a reach of several miles could indicate a sediment location shift of millions of cubic yards.

This (1984) was the second year of profiling using a hydrostatic profiler developed by the Ocean Engineering Research Group, Institute of Marine Resources, Scripps Institution of Oceanography. In 1984, 75 profile lines were taken in the Spring, and the program was expanded to 100 profile lines in the Fall.

METHODS

The profiling method used was similar to that employed in 1983 (see CCSTWS 84-2). A sled was towed offshore to a point approximately -20 feet MLLW, sunk, and then towed shoreward along a predetermined line by a winch. A pressure sensitive device on the sled, connected to the shore mobile station by cable, responded to pressure differences as the sled was towed shoreward. These pressure differences were recorded and later translated into depth readings.

For 1984, the hydrostatic system was modified. The cable was re-designed to give it higher specific gravity and thus greater resistance to vibration by waves, and the winch drawing the sled to the shore was re-geared to accomodate the new cable. In 1985, a new bathymetry method will be used.

RESULTS

Data from this profiling program are available, and are now being analyzed. A report will be developed when enough data are available to draw conclusions about profile changes and factors influencing them (Summer 1985). Profiles and depth tables for the 75 sites samples in 1984 are available to researchers through the CCSTWS.

DISCUSSION

A new profiler is now available which will permit accurate profiles to be taken to -40 feet MLLW, replacing the hydrostatic profiler, which was limited to depths of about -20 feet MLLW because of limited cable length. The new device (see next section) will allow more precise measurements of onshore/offshore sediment movement.

Increasing operating depth to -40 feet should also ensure that profiles reach the depth of "closure." This is the depth at which no significant movement of sediment occurs as a result of wave action.

TECHNICAL SUMMARY: NEW BATHYMETRY METHOD

DEVELOPED FOR SURVEYING NEARSHORE PROFILE

INTRODUCTION

The hydrostatic profiler used in the first years of profile measurements in the San Diego Region was more accurate than any previous method, but was limited in range because of its 1800-foot cable. The new method uses a masted sled with reflectors at the top of the mast. A laser tracks the reflectors, recording changes in reflector height as the sled moves along the bottom.

The new sea-sled technique was developed as a part of work being performed on the Oceanside Experimental Sand Bypass System. This system is designed to move sediment around Oceanside Harbor to beaches downcoast, beaches severely eroded during the last 40 years. A precise profiling method was needed to monitor impacts of the bypass system on the Oceanside Beach.

A very high degree of accuracy in profiling was required in monitoring results of this experiment because sediment movement would be on a continuous basis, and thus small amounts of sediment would be moved. The need to measure small changes in profile elevation, and to measure between -20 and -40 feet MLLW made a new technique necessary. Accordingly, the Coastal Engineering Research Center has developed a profiler which permits quick and accurate nearshore profiles.

NEW METHOD

The new sea-sled method takes advantage of the precision of the laser beam. A lightweight sled (Figure 9) fitted with a tall (60-foot) mast is the moveable portion of the system. The mast carries two reflectors (Figure 10). As the sled is towed seaward, the laser tracks the reflectors, recording both horizontal and vertical movement (Figure 11). As the sled moves along the ocean bottom, the mast relationship to the fixed laser source changes, and these changes in laser angle are converted by computer to changes in depth.

The new method is capable of vertical resolution of 0.1 ft or less and horizontal resolution of 0.5 ft or less. The profiler is capable of measuring depths to -40 feet or beyond, or more than double the depth currently being measured by the hydrostatic profiler.

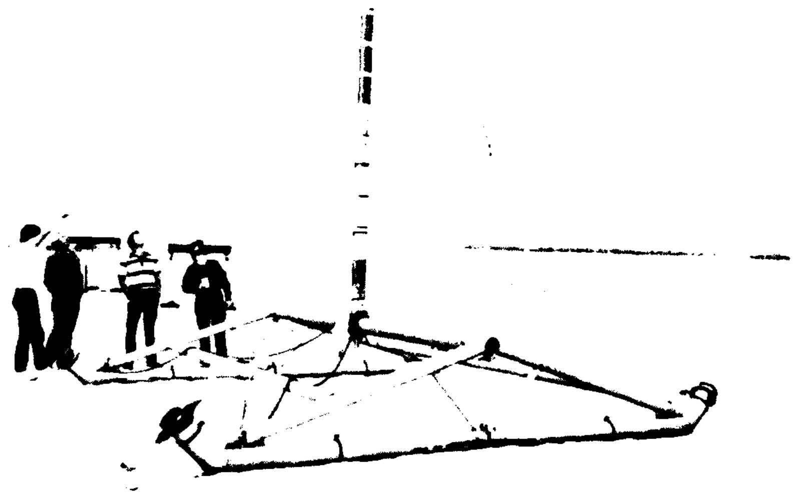

Figure 9. A prototype version of the sea sled to be used for beach profile surveys.

Figure 10. Reflector assembly on profiling sled mast.

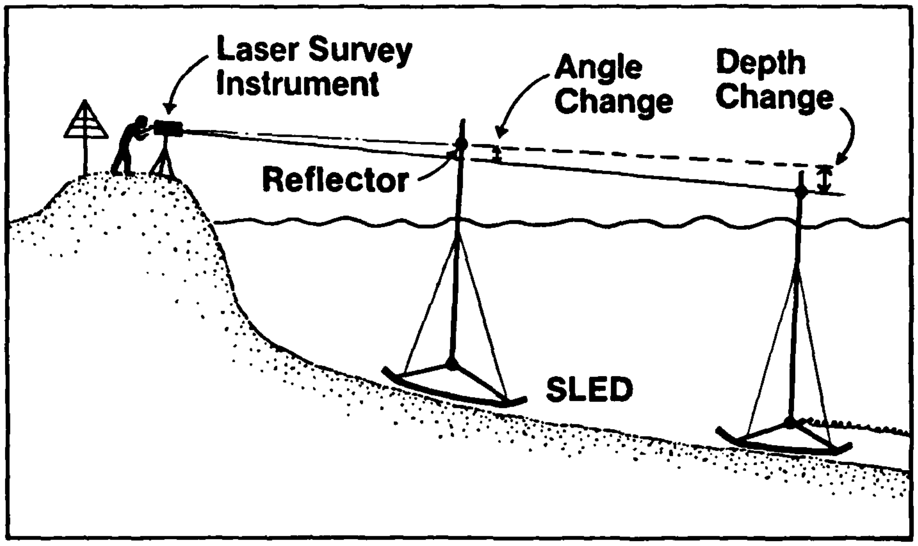

Figure 11. The operation of the new bathymetry method. As the sled is towed to sea, it follows the profile of the bottom. The laser on shore tracks the reflector. As the sled moves, the angle of the laser to the horizon changes, and these angle changes are converted, by computer, to changes in depth.

TECHNICAL SUMMARY: BUOY MEASURING DIRECTIONAL WAVE SPECTRA DEPLOYED OFF SOUTHERN CALIFORNIA

INTRODUCTION

A number of wave climate measuring devices are being used by CCSTWS to obtain accurate data about waves approaching the coast. There are few offshore measuring devices, and they are expensive. so deployment of such devices is a major step in study development.

Waves in the San Diego Region are being monitored by 5 nearshore wave gauges cooperatively funded by CCSTWS and the Coastal Engineering Research Center (CERC), and operated by Scripps Institution of Oceanography (SIO). These "slope array" gauges provide wave height, period, and direction data. They are located between San Clemente and the Mexican Border (Figure 12). The existing wave gauge network off the San Diego Region also includes a NOAA Buoy approximately 50 miles WSW of Palos Verdes Peninsula, and a SIO buoy just northwest of San Nicholas Island.

Much of the San Diego Region is sheltered from deep ocean waves by major offshore islands, which may modify waves significantly. A wave measuring buoy seaward of these islands is an essential component of CCSTWS.

A new buoy, with significantly advanced azimuth angle-measuring ability, has been placed outside of the channel islands about 120 miles southwest of Los Angeles. Deployed and operated by NOAA with Corps participation, this buoy will provide a continuous stream of data to the CCSTWS and other researchers.

BUOY CAPABILITIES

The buoy, deployed on April 14, 1984, is a 33-foot-diameter discus buoy (Figure 13). It contains a Datawell HIPPY 40 heave/pitch/roll sensor, a triaxial magnetometer, and a computer capable of wave data acquisition and reduction. It is similar to the Experimental Environmental Research Buoy (XERB) deployed as a part of the Atlantic Remote Sensing Land Ocean Experiment (ARSLOE). The new buoy, deployed in water about 4500 feet deep, should give azimuth angles to within 5 degrees for any hull orientation.

As can be seen in Figure 12, the new buoy is the only wave monitoring device placed entirely seaward of the channel islands and other wave modifying ocean features such as the Tanner & Cortez Banks. The buoy will thus provide us with

highly accurate data on deepwater waves as they approach the coast. Data from this buoy can be compared to data from nearshore wave gauges, and the influence of nearshore topography on waves can be determined.

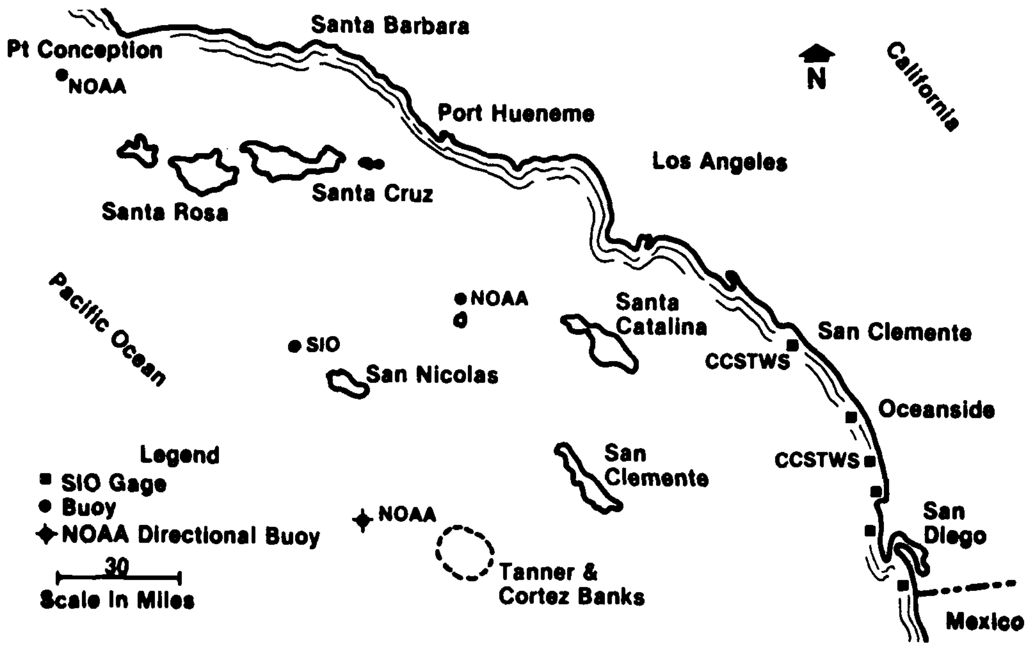

Figure 12. The Wave Monitoring Network for the San Diego Region.

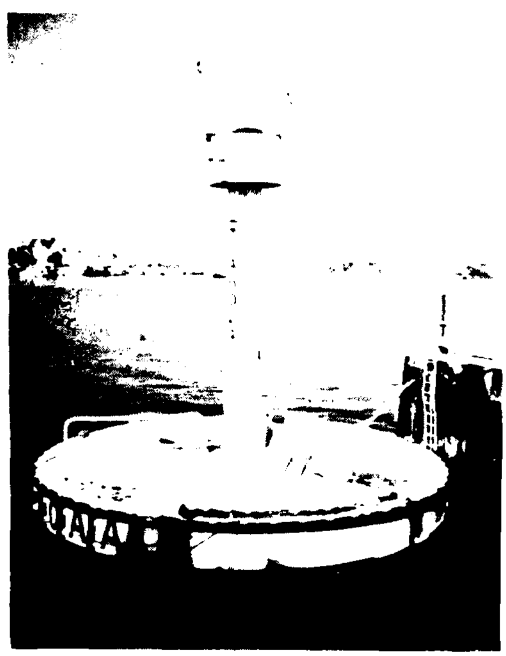

Figure 13. The New NOAA Directional Buoy.

TECHNICAL SUMMARY: GEOMORPHOLOGY FRAMEWORK STUDY, MONTEREY BAY, CALIFORNIA

INTRODUCTION

The geology and geomorphology of the coastline must be understood in order to develop a sound understanding of coastal processes. The shape of the shoreline, the characteristics of local and inland rock and soils, and the orientation of the coastline to azimuth all affect the quantity and movement of sediments.

An effort to compile, evaluate, and interpret existing geologic and geomorphic data on each coastal zone is an important step in understanding the processes by which sediments are brought to the littoral zone and where they go once they get there. Existing knowledge can point to specific sites for sediment sampling, and can identify historic phenomena (landslides, tectonic events) which may explain some aspects of shoreline configuration.

METHODS

This is the second geomorphology framework study. The first, described in detail in the 1983 CCSTWS Annual Report, covered the San Diego Region, and was one basis for the San Diego Region Plan of Study.

The geomorphology framework study of the Monterey Bay area was the initial step in expanding CCSTWS to regions outside of Southern California. It involved survey of existing data on five subjects:

1. Littoral zone resources
2. Basin sediment resources
3. Coastal cliff resources
4. Sand and gravel mining
5. Coastal tectonics

These data were analyzed to establish a general description of how sediment is produced and carried to the littoral zone. Using this conceptual description based on previously collected data, a detailed field study plan can be developed.

RESULTS

Results of this review are unavailable for release at this time. The analysis of data assembled is underway, and a report will be published in late Spring. Results will be summarized in the second-quarter CCSTWS bulletin.

TECHNICAL SUMMARY: SUBMARINE CANYON STUDY,

SCRIPPS, LA JOLLA, AND CARLSBAD SUBMARINE CANYONS

INTRODUCTION

Onshore and offshore movement of sediment is a common phenomenon, and often there is no long term loss of sediment. Sediment is moved offshore by large winter storms and is often brought back to the beach by summer wave action.

Sediment lost to submarine canyons is lost permanently. Given the high cost of replacing such sediment through beach nourishment programs, and given recent estimates that several hundred thousand cubic yards are lost annually in the San Diego Region, an understanding of the mechanism for these losses, and of the magnitude of the losses, is essential.

METHODS

Accurate measurement of the quantity of sediment lost to each canyon was made in numerous ways. First, detailed bathymetric surveys of canyon heads were made with echo sounder supplemented by diver surveys. Second, divers took surface and subsurface sediment samples at canyon heads and these samples were compared to sediment from near adjacent beaches. Third, surveys of sediment thickness were made where possible, and sediment traps were placed along canyon rims to monitor the rate and nature of material moving into the canyons. Finally, flushing timers were used to establish the time and date of sediment downslope movement. These data are used to identify conditions leading to mass sediment movement into the canyon.

Following initial bathymetric survey, infilling was measured weekly at Scripps Canyon (a rapidly filling canyon) and on a less frequent basis at the other two locations.

This work was begun in 1984, and will continue until an adequate understanding of the sediment losses to these canyons is attained.

RESULTS

Data collection began in November 1984 and has been on-going since that date. Dive surveys have been conducted at a rate of 2 per week, with 2 dive teams making 2 dives per day per survey. Surveys in deep water have been limited due to the short working time available in deep dives.

The study has been underway for approximately 6 months. It will continue for some time before a final analysis is made. Nevertheless, some preliminary observations have been made which should be of interest to researchers and planners:

1. Reconnaissance of Carlsbad Canyon indicates that it is not a significant factor in sand losses. The head of the canyon is in 100 feet of water, and no sediment was observed moving into the canyon during the diving surveys.

2. From December 12 to 14, 1984, a period of wave storm, the sediment build-up in the Scripps Canyon completely flushed into the canyon. Both canyon branches were affected. Since that date, infilling of the canyon head has been occurring, but at a lower rate than reported in previous studies. This may reflect the mild winter conditions of the 84-85 winter along the southern California coast.

3. In La Jolla Canyon, only a small amount of sediment has been infilling the canyon head, a result consistent with the phenomenon observed in Scripps Canyon.

DISCUSSION

It is too early to speculate on rates of infilling or on the mechanisms for sediment loss into the canyons. Data collection is continuing, and an analysis will be published in 1986.

HOW TO RECEIVE CCSTWS INFORMATION

CCSTWS is a tax supported project, and we want to keep costs to an absolute minimum. Nevertheless, it's important that information about CCSTWS, and the results of its studies, reach interested people. We want the information we develop to be both useful and well-used.

If you would like to get on or remain on the CCSTWS mailing list, please fill out the form below. If you do not return the form, your name will be deleted from the mailing list.

Once on the mailing list, you will regularly receive the CCSTWS Quarterly Bulletin and the Annual Report. Technical study reports will be described in the bulletin and annual report, but will not be provided on a routine basis. If you need a technical report, please request it specifically from CCSTWS Project Manager, at one of these addresses:

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Coastal Resources Branch, SPLPD-CS
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P.O. Box 2711
Los Angeles, CA 90053-2325

or

U.S. Army Corps of Engineers
San Francisco District
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